October 8, 2008

M E M O R A N D U M

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SUBJECT: Bogus Basin Recreational Association Wastewater Reuse Permit Application Review -- LA-000080-03 (Municipal Wastewater Facility)

1.0 Purpose

The purpose of this memorandum is to satisfy the requirements of IDAPA 58.01.17.400 (Rules for the Reclamation and Reuse of Municipal and Industrial Wastewater) for issuing wastewater reuse permits. It states the principal facts and significant questions considered in preparing the draft permit conditions or intent to deny, and a summary of the basis for approval or denial with references to applicable requirements and supporting materials.

2.0 Process Description

Bogus Basin Recreational Area (BBRA) is located approximately 16.5 miles north of Boise on Bogus Basin Road at elevations which range from 5,800 feet (ft) at the base to 7,582 ft at the top. Wastewater treatment at BBRA takes place at two separate systems, the Pioneer System and the Bogus Creek System. The Pioneer System receives influent from the Pioneer Lodge, the nearby Pioneer Condominiums, and the Frontier Point Nordic Ski Lodge while the Bogus Creek System receives wastewater from the J.R. Simplot Lodge (formerly Bogus Creek Lodge). Both systems are comprised of three lagoons operated in series which combine for a total of 1.8 million gallons (MG) and 1.2 MG of storage and treatment capacity for the Pioneer System and Bogus Creek System, respectively.

When wastewater enters the Pioneer System it flows first into Pioneer Lagoon No. 1, a 440,000 gallon (gal) aerated lagoon, and then into either Pioneer Lagoon No. 2 or Pioneer Lagoon No. 3 which are both storage lagoons with adjacent land application sites. Pioneer Lagoon No. 2 has a capacity of 380,000 gal and is non-aerated while Pioneer Lagoon No. 3 is a 943,000 gal lagoon with surface aeration. Influent flow from the Nordic Ski Lodge enters directly into Pioneer Lagoon No. 3, by passing the first treatment lagoon.

As in the Pioneer System, influent flow to the Bogus Creek System initially enters Bogus Creek Lagoon No. 1, which is a 155,000 gal aerated treatment lagoon. From there it proceeds into the 374,000 gal Bogus Creek Lagoon No. 2 and then to the 716,000 gal Bogus Creek Lagoon No. 3, both of which are also aerated. The wastewater is then discharged from Lagoon No. 3 to the adjacent land

application area. The capability also exists to transfer effluent from the Bogus Creek System to the Pioneer Lagoon No. 3, should the land application site be unavailable (CH2M HILL, 2007a).

3.0 Summary of Events

The facility's most recent wastewater reuse permit, LA-000080-02 was issued on April 1, 1996 and subsequently expired March 29, 2001. A permit renewal application, which contained plans for both a condo expansion and the use of wastewater in snow production, was submitted on July 20, 2006. Plans for the facility were subsequently revised and a new application, the one upon which this analysis is based, was submitted in December of 2007. In the interim, the facility has generally continued to operate under the requirements of LA-000080-02.

4.0 Discussion

The following is a discussion of: soils, ground water, surface water, hydraulic management unit configuration, wastewater flows and constituent loading, site management, and compliance activities. Conclusions and recommendations are summarized in Section 5 below.

4.1 Soils

The Natural Resources Conservation Service (NRCS) has characterized the area, listing the principal soil for all of the land treatment areas as Eagleson – Kosh complex with 25 – 90 percent slopes. This particular complex is typically described as a fine, dry, gravelly sandy loam and is somewhat excessively drained. The estimated available water holding capacity (AWC), or water held in the soil that is available for plant use, is very low at just 1.9 inches, which is fairly typical given the mountainous location (NRCS, 2007).

The facility's initial permit, LA-000080-01, required soil monitoring for a certain number of select constituents, namely chloride, Total Kjeldahl Nitrogen (TKN), nitrate, and electrical conductivity. Prior to the discontinuance of this monitoring with the issuance of LA-000080-02 in 1996 all of the parameters sampled for remained within the low to very low range with the exception of a few scattered nitrate-nitrogen excursions in moderately high range on the field adjacent to Pioneer Lagoon No. 2. However, as loadings to the site have been rather variable during the last permit cycle (1996-present) and since the facility has no monitoring well network it is recommended that soil monitoring be reinstated, to take place in the fall during the first and last years of the permit. For further discussion on the sites' ground water and constituent loading rates, see Sections 4.2 and 4.5.2, respectively.

4.2 Ground Water

As the facility is located in a rather remote mountainous location, little information is available on the area's ground water. It is estimated that the depth to first water at the land application sites is anywhere from 30 to 60 ft below ground surface (bgs) (CH2M HILL, 2007b). Based upon BBRA's well logs it appears that a deeper, possibly regional, level of ground water is reached between 350 to 500 ft bgs. Given the location of the treatment fields in relation to both the summit and to Bogus Creek, it is reasonable to assume that ground water in these areas likely flows in a south to southwest direction down hill towards the creek.

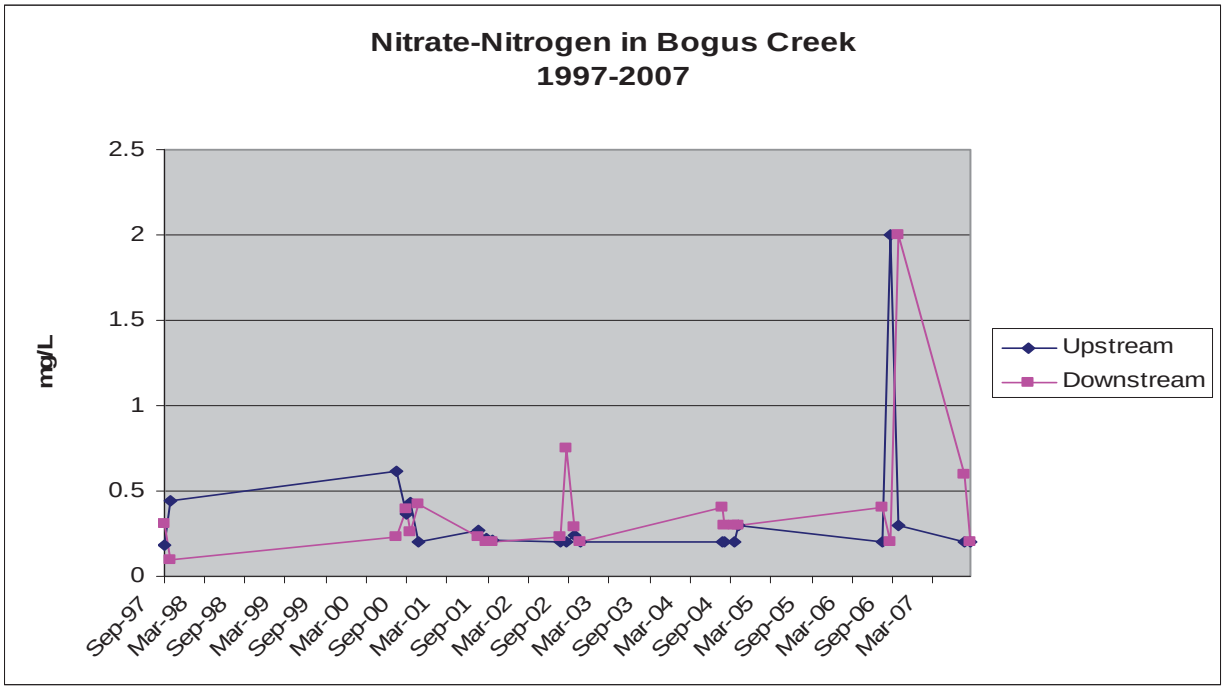
Currently, this facility has no monitoring well network. During the 1996 re-permit process it was determined that such a network was unnecessary due to the fact that projected hydraulic and constituent loadings to the site were such that they would either be at or below "crop" requirements, with the crop in question being the naturally occurring forest and undergrowth. Current loadings remain such that staff feels that the site can continue to operate with little potential for adverse ground water impacts. For further discussion of current and anticipated constituent and hydraulic loadings please refer to Section 4.5.

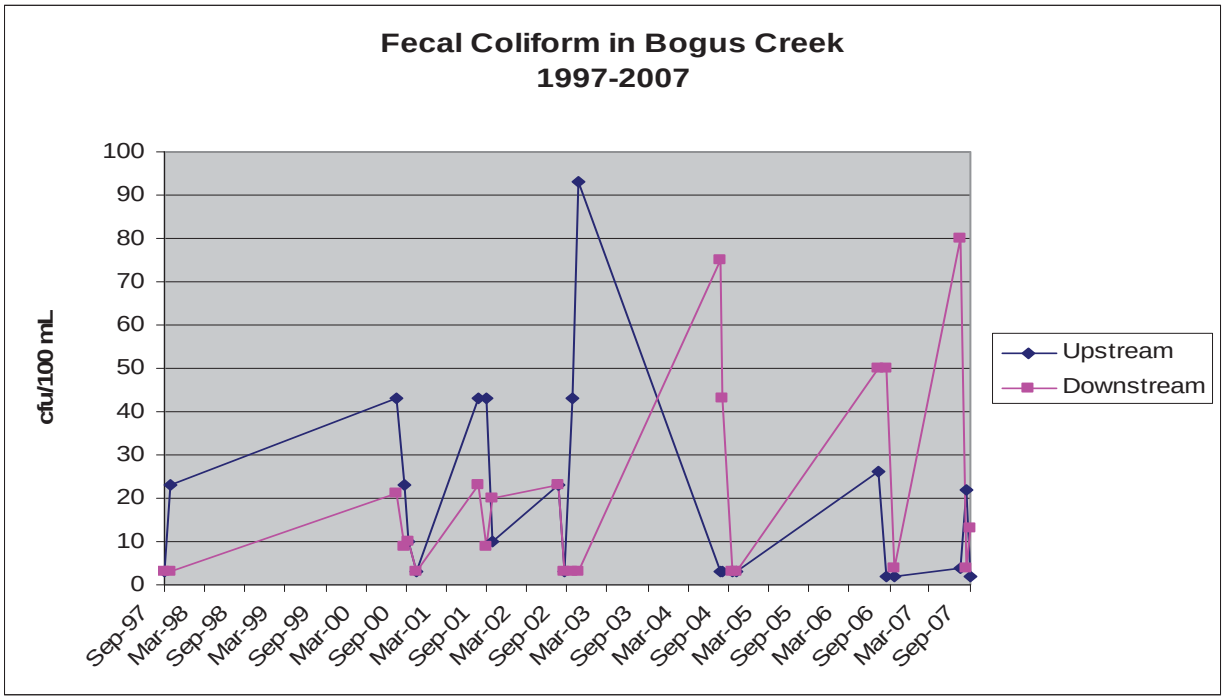
4.2.1 Municipal and Domestic Wells in Proximity to the Facility

Due to the remoteness of these sites there are no municipal or domestic wells located within a quarter mile of any of the land application fields. The production well for the recreation area is located approximately 0.6 miles away from the nearest wastewater application site and is likely cross-gradient.

4.3 Surface Water

Bogus Creek flows near both the land application site adjacent to Pioneer Lagoon No. 3 and the Bogus Creek Site. However, the Bogus Creek Site is located in much closer proximity to the creek, with the land treatment field being 100 feet away and Bogus Creek Lagoon No. 3 being only 30 feet away. While the application field meets the minimum recommended buffer zone distance for surface water, it was determined during the previous permit renewal process that, given the proximity and the type of wastewater being applied, the creek should be monitored both upstream and downstream for nitrate-nitrogen and fecal coliform. Refer to the plots below for the results of the stream monitoring from 1997-2007.





As evidenced by the graphs above, it appears that the land treatment site has had little to no influence upon the creek waters. Any spikes in either nitrate or coliform downstream are usually preceded by corresponding spikes upstream and at times the water downstream of the site actually appears to be of better quality than that upstream. However, given the proximity of the site to the creek staff feels it is still prudent that monitoring continue through the next permit cycle with the addition of total phosphorus as one of the parameters. See Section 4.5.2.4 for further discussion on phosphorus loadings to the sites and Section 4.7 for further buffer zone discussion. It should also be noted that in addition to the water supplied by the aforementioned production well, the creek also supplies drinking water for various sites at the BBRA. This water is pulled from the creek and filtered near the well location, east of the J.R. Simplot Lodge and well upstream of the land application and lagoon areas.

4.4 Hydraulic Management Unit Configuration

The entire BBRA land application area totals 5 acres, divided into three separate management units. These sites are irrigated by drip lines. As was previously mentioned, the Pioneer System has two of these units adjacent to its lagoons while the Bogus Creek System possesses the remaining unit. The first unit, located near Pioneer Lagoons No. 1 and No. 2, comprises a total of 0.82 acres and was only used sporadically for land treatment up until 1997. The remaining two units totaling 2.06 acres and 2.12 acres are located adjacent to Pioneer Lagoon No. 3 and Bogus Creek Lagoon No. 3, respectively. Both these units have been in consistent use since the early 1990s. No changes have been proposed to the current hydraulic management units, so staff recommends that unit designations remain the same as those in LA-000080-02; however, it is suggested that the facility calculate both constituent and hydraulic loadings in units per acre rather than total pounds or inches applied to the site as has been done previously. Please refer to the draft permit, Section G for the monitoring requirements and Appendix 2 for the hydraulic management unit designations.

4.5 Wastewater Flows and Constituent Loading Rates

Trending of wastewater flow rates and rationale for constituent and hydraulic loading rates appearing in the draft permit are discussed below.

4.5.1 Wastewater Flows

During the 1996 re-permit the current capacity at which the lagoons were being operated was calculated using the yearly effluent volumes from 1992 to 1995 and the lagoon capacities. Though these values did not account for either evaporative or seepage losses, they do give a general estimate of lagoon usage during this timeframe. On average, the Bogus Creek system was being operated at 75% capacity while the Pioneer System was being operated at just 55% capacity. At the time it was projected that the overflow system which connects the Bogus Creek system to the Pioneer System would be needed in order to accommodate the expected additional influent flow as a result of the increasing number of skier visits per year. However, beginning in 1998 the facility began replacing their various sinks, toilets, showers, etc. with low flow versions which appears to have more than effectively compensated for any increase in skier visits. Over the course of this permit cycle the Bogus Creek System has averaged 54% capacity and the Pioneer System 53% capacity; the overflow connection between the Bogus Creek System and Pioneer Lagoon No. 3 remains an emergency backup option and is not regularly employed during the course of the season; taking these factors into account, the currently available storage capacity should be more than sufficient for at least the next permit cycle. For a more detailed discussion of current and future hydraulic loading rates see Section 4.5.2.1.

4.5.2 Loading Rates

The sections below discuss proposed loading rates, including hydraulic, nitrogen, chemical oxygen demand (COD), and phosphorus. Recommended loading rates for inclusion into the draft permit, Section F, are also discussed.

4.5.2.1 Hydraulic Loading Rates

Permit LA-000080-02 gave the total maximum hydraulic loading for the three land application sites combined as 3.1 MG per year or 22.8 in/ac-yr. All three sites have been substantially below this limit for the majority of the last permit cycle, with the Bogus Creek Site averaging 14.4 in/ac-yr and the Pioneer No. 1 and No. 2 Site and the Pioneer No. 3 site averaging 15.1 in/ac-yr and 14.9 in/ac-yr, respectively.

Typically, wastewater reuse permits include a hydraulic loading limit which is substantially the irrigation water requirement (IWR) for the crop in question. Though this site is not harvesting a crop as such, it is recommended that the facility still be allowed to apply wastewater up to the IWR for the forested site, constituent loading permitting. Since a substantial portion of the forested areas in the Boise Basin area consist mainly of Ponderosa Pine with patches of Douglas Fir the following assumptions were made when calculating BBRA's IWR: 50% of the land application area is populated by Ponderosa Pine, 25% is populated by Douglas Fir, and the remaining 25% is covered by the native grass understory. These assumptions and the formula below were used to estimate the IWR for a forested site watered via sprinkler irrigation.

$IWR = (CU - PPT_e)/E_i$

Where:

CU = Consumptive Use
PP_T = Effective Precipitation from Jul-Oct (70% of Gross Precipitation)
E_i= Irrigation Efficiency

	CU[1] (in/ac)	PPT_e [2](in)	E_i %	IWR (in/ac)
Ponderosa Pine	15.5	2.38	70	18.7
Douglas Fir	16.0	2.38	70	19.5
Native Grass	18.0	2.38	70	22.3

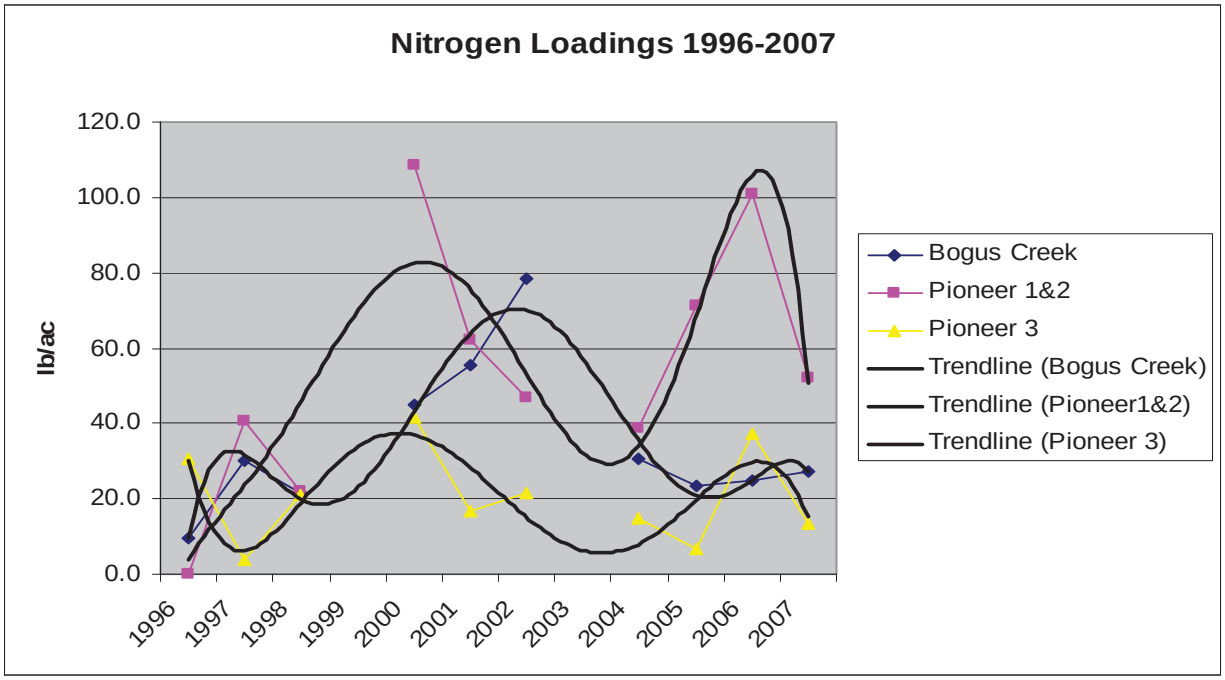
1. Johns, 1989
2. National Weather and Climate Center, 2007

When weighted in the aforementioned manner, these individual water requirements give an individual IWR for the sites of 19.8 in/ac or a total of 2.7 MG for all three sites combined. While some of the sites may have come close to this loading limit in the mid-90s, none as ever exceeded it, nor does it appear that they will during the next permit cycle, due to a reduction in water usage associated with the low-flow conversion. It is more likely that nitrogen loading, rather hydraulic loading, will prove to be the more limiting factor at these sites. For further discussion of wastewater flows and constituent loadings, see Sections 4.5.1 and 4.5.2.2 through 4.5.2.4, respectively; for the recommended hydraulic loading limits, see Section F of the draft permit.

4.5.2.2 Nitrogen Management and Loading Rates

Wastewater Reuse permits typically include a nitrogen loading rate limit of 150% of typical crop uptake; however, as wastewater is being applied to a naturally forested area rather than a seasonally harvested crop whose tissues could be sampled for constituent uptake, the parameters of this kind of limit would be rather difficult to determine. An older growth stand (aged 25-40 years) of Ponderosa Pine and Douglas Fir has a typical nitrogen uptake between 30 to 45 pounds per acre (lbs/ac); given the fact that wastewater is applied yearly it is likely that the build-up of the understory is such that the trees are currently the sole source of nitrogen uptake (Henry et al, 1999). In keeping with the 150% guideline and in the interest of protecting the site's ground water, it is recommended that the facility be given a nitrogen loading limit of 70 lbs/ac, which is approximately 150% of the upper end of the aforementioned nitrogen uptake values.

The nitrogen concentration of the systems' wastewater appears to fluctuate a fair amount from year to year, possibly due in part to the facility's sampling procedures. These variations in concentration have consequently lead to corresponding oscillations in nitrogen loading rates, particularly at the Pioneer Lagoon No. 1 and No. 2 Site. Refer to the graph below for the nitrogen loadings to the land application fields during the previous permit cycle (1996-present).



Despite these rather wide variations, each of the sites' average loading rates over the past decade has been well below the proposed loading rate. There have only been a few instances where the 70 lb/ac mark has been exceed, twice on the Pioneer 1&2 Site and once on the Bogus Creek Site. As was previously mentioned, a certain amount of these concentration and loading rate fluctuations could be due to the way the facility is sampling, as the wastewater influent and effluent quality should in theory remain the generally the same each year provided all lagoon systems are functioning properly. In is unclear as to exactly where and how the facility has been drawing their wastewater samples in the past. Many of them may have come directly off the surface of the lagoons themselves, which are often coated with algae during the summer months, affecting the quality of the sample; this is particularly true of Pioneer Lagoon No. 2 which is currently un-aerated and therefore less well mixed. In order to address this ambiguity and in the hopes of retrieving a more standard and representative picture of the facility's wastewater, staff recommends that the facility draft a Quality Assurance Project Plan which covers field activities including laboratory analytical methods and other activities; data storage, retrieval and assessment; and monitoring program evaluation and improvement. For the full text of this condition see CA-080-02 in Section E of the permit.

In the event that the nitrogen loading rate fluctuations discussed above are not resolved through the increased scrutiny of sampling methodologies, and specifically, if annual loading rates continue to drift above the permit limit of 70 lbs/ac, the provisions of Compliance Activity CA-080-04 require that BBRA investigate the treatment process for potential improvements that would reduce the nitrogen loading rates. The improvements to be evaluated should include both operational changes, as well as the potential for system modifications, such as adding aeration to Pioneer Lagoon No. 2. This provision will only be triggered if the nitrogen loading rates exceed the loading rate limit contained in the permit. Refer to CA-080-04 in the draft permit for additional details.

4.5.2.3 COD Loading Rates

Wastewater reuse permits typically include a COD loading rate limit of 50 pounds/acre-day (lb/ac-day) per season. During the last permit cycle the Bogus Creek site averaged 0.4 lb/ac-day while the Pioneer

No. 1 and No. 2 Site and the Pioneer No. 3 site averaged 5.3 lb/ac-day and 3.0 lb/ac-day, respectively. None of the sites ever achieved a seasonal COD loading greater than 9.2 lb/ac-day. In light of these historic loading rates it is considered very unlikely that the facility will exceed the 50 lb/ac-day seasonal average and, therefore, no COD loading rate limit has been included in the permit, although monthly monitoring of this parameter is still required.

4.5.2.4 Phosphorus Loading Rates

Currently, there is no phosphorus loading limit included in the draft permit, as phosphorus loading rates are generally set by DEQ based upon either ground water or surface water concerns. While it is possible that a ground water-surface water interconnection does exist, given the moderate average historic loading rates which range between 14.1 and 27.2 lb/ac depending upon the site, it is unlikely that a significant amount of phosphorus is reaching the ground water beneath the sites. Typically, forested sites use between 5 to 10 lbs/ac of phosphorus per year, making it likely that at least 50% of the constituent applied will be used by the existing plant growth while the remainder will stay in the soil, becoming less soluble over time (Ducnuigeen et al, 1997). Given an adequately designed runoff plan, phosphorus contamination to Bogus Creek should not become a concern; therefore, it is recommended that a Runoff Management Plan be submitted which details the best management practices the facility plans to employ in the prevention of runoff. For the full text of this condition see CA-080-06, Section E of the draft permit. It should be noted that the permit does require monitoring of total phosphorous in the effluent from the lagoons to allow proper oversight of this nutrient.

4.6 Buffer Zones and Disinfection

Effluent from the BBRA systems is not disinfected and as such it is considered to be Class E wastewater, with coliform counts which have historically ranged anywhere from 3 colony forming units per 100 mL (cfu/100 mL) to greater than 2,400 cfu/100 mL. The recommended buffer zone distances for this type of wastewater are as follows:

- 1000 ft from reuse site and public water supply wells
- 1000 ft from reuse site and inhabited dwellings
- 1000 ft from reuse site and areas of public access
- 500 ft from reuse site and private potable supply wells
- 100 ft from reuse site and permanent or intermittent surface water
- 50 ft from reuse site and irrigation ditches/canals

Though the facility currently meets the recommended distances for wells, dwellings, and surface water, the restriction of public access appears to be somewhat of an issue. A number of Nordic ski trails run near these areas in the winter as well as variable mountain biking and hiking trails in the summer. The facility has previously stated that permanent fencing, as is typically recommended for this type of site, is not feasible due to the aforementioned ski trails. In order to resolve this issue in a manner that is both protective of the public health and logical for this particular site, it is recommended that the facility submit a Public Access Restriction Plan. The plan shall include, at a minimum, the addition of large, highly visible signage with regard to the effluent application posted every 250 ft, an irrigation schedule which times wastewater application for periods of non-use by the public, specific proposed public access buffer zones for each HMU and justification for said zones if they differ from those listed above, and any other mitigation measures which can feasibly be employed to restrict public access from both the land treatment and lagoon areas. For the full text of this requirement, see CA-080-05 in Section E of the draft permit.

4.7 Plan of Operation and Other Compliance Activities

Section 1.0 of the Application (page 1) states that an updated facility plan of operation would be submitted after permit issuance as an anticipated permit compliance condition. It is understood that a plan of operation is a living document and is modified as operations and regulatory requirements change. Section E, condition CA-080-01, as it appears in the draft permit requires the facility to submit a detailed Plan of Operation for DEQ review and approval. For the full text of this condition, see Section E of the draft permit.

In order to address a number of uncertainties with regard to the facility's sampling and monitoring practices as well as the wide variation of their wastewater constituent concentrations it is recommended that BBRA submit a Quality Assurance Project Plan for DEQ review and approval. For the full text of this condition see CA-080-02, Section E of the draft permit; for further discussion on wastewater concentrations see Section 4.5.2 of this document.

Several of the facility's wastewater lagoons have been seepage tested since the issuance of LA-000080-02 in 1996. The most recent tests took place on Bogus Creek Lagoon No. 3 and Pioneer Lagoons No. 1 and No. 3 in June of 2007. While the results from these tests were inconclusive for Pioneer Lagoon No. 1 and Bogus Creek Lagoon No. 3, it was found that Pioneer Lagoon No.3's seepage rate was greater than the allowable rate of 0.25 in/day. On September 12, 2008, DEQ issued an approval letter for plans and specifications for installation of a new liner in Pioneer Lagoon No. 3. DEQ understands that this project will be completed in 2008, although a seepage test for the new lagoon will not be possible until 2009. Compliance Activity CA-080-03 requires that BBRA submit a plan and schedule for testing all wastewater storage structures. After approval of the plan, BBRA has 48 months to complete the testing in accordance with the approved plan.

As discussed under Section 4.5.2.2 of this document, the nitrogen loading rates associated with effluent from the Pioneer Lagoon Nos. 1 & 2 fluctuates widely, and have exceeded the permit limit of 70 lbs/acre from time to time. It is unknown if these fluctuations are due to issues with sampling (i.e., non-representative samples may be skewing the estimated loading rates to the sites), or due to inconsistencies in the treatment train itself. In the event that loading rates exceed the permit limit in the future, CA-080-04 requires that BBRA investigate the treatment process for potential improvements that would reduce the nitrogen loading rates and ensure continued compliance with the terms of the permit. The improvements to be evaluated will be identified within a plan, due 6 months after the exceedence is noted, and should include both operational changes and potential system improvements, such as adding aeration to Pioneer Lagoon No. 2 or expanding the acreage of the treatment site(s). Upon approval of the proposed plan, BBRA is required to implement the plan and submit the results to DEQ for review and approval.

In the interest of addressing the issue of restriction of public access to the land application sites and lagoon areas in a manner which is both protective of public health and logical for this particular site it is recommended that the facility submit for DEQ review and approval a Public Access Restriction Plan. For further discussion on buffer zones and public access see Section 4.6; for the full text of this compliance activity see CA-080-05, Section E of the draft permit.

Due to the amount of phosphorus loading which has occurred over the past several years versus the probable amount of uptake of this nutrient by the native forest it is recommended that the facility develop a comprehensive Runoff Management Plan. This plan should be particularly targeted towards

preventing any runoff from reaching nearby Bogus Creek. For further discussion on phosphorus loadings see Section 4.5.2.4; for the full text of this compliance activity see CA-080-06, Section E of the draft permit.

5.0 Conclusion

The following recommendations fall into three major areas. They include loading rate related recommendations, surface water related recommendations, soil related recommendations, and other recommendations.

5.1 Loading Rate Related Recommendations

1. It is recommended that all hydraulic management units be managed and loaded hydraulically during the growing season as discussed in Section 4.5.2.1. See Section F of the draft permit.

2. It is recommended that all management units have a nitrogen loading rate 70 lbs/ac-yr as discussed in Section 4.5.2.1. See Section F of the draft permit.

5.2 Surface Water Related Recommendations

It is recommended that total phosphorus be added to the surface water monitoring requirements for Bogus Creek as discussed in Section 4.3. See Section G of the draft permit.

5.3 Soil Related Recommendations

It is recommended that soil monitoring be re-instated on an intermittent basis as discussed in Section 4.1. See Section G of the draft permit.

6.0 References Cited

CH2M HILL, 2007a. Bogus Basin Wastewater Reuse Plan of Operation, December 2007

CH2M HILL, 2007b. Bogus Basin Recreation Reuse Permit Application Technical Report, December 2007

Department of Environmental Quality, 2007. Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater-Revised, April 2007

Ducnuigeen, Jan et al, 1997. Relative Nutrient Requirements of Plants Suitable for Riparian Vegetated Buffer Strips. September 1997.

Henry, Charles et al. Managing Nitrogen from Biosolids. 1999.

Johns, Eldon L. Water Use by Naturally Occurring Vegetation Including an Annotated Bibliography. 1989

National Resources Conservation Service, 2007. Soil Survey of Boise County Area, Idaho, February 2007.

National Weather and Climate Center (NWCC), 2007. Site Information and Reports for Bogus Basin. 2007. http://www.wcc.nrcs.usda.gov/snotel/snotel.pl?sitenum=978&state=id